Example – openPDC on Raspberry Pi 3 Model B, Raspbian Jessie

This implementation summary uses the following software and hardware:

- Grid Protection Alliance openPDC Product Release Latest Stable Version 2.2.70.0
- **Raspberry Pi 3 Model B** with Raspberry Pi 7" touchscreen and Pi's Wifi or wired Ethernet.
- Raspbian Jessie Full Desktop 2016-05-27
- mono default wheezy version

Raspberry Pi Setup

1. Download Raspbian Jessie Full Desktop image from:
   https://downloads.raspberrypi.org/raspbian_latest

2. Write the image to an SD card.
   https://www.raspberrypi.org/documentation/installation/installing-images/README.md

3. Boot the Raspberry Pi using the SD card. Run the Raspbian desktop Menu / Preferences / Raspberry Pi Configuration.
   A. Expand the Filesystem
   B. Change the **pi** user's password from ***raspberry*** to a new password.
   C. Set the Internationalization Options for Locale and Timezone
   D. Set the Advanced Options to enable SSH and set the Pi's Hostname
   E. Reboot the Pi
4. Configure the Pi's Ethernet to connect to the LAN and Internet.
   A. Make a note of the Pi's IP address

```
sudo ifconfig -a
```

5. By default, the Pi can now be accessed by remotely using a terminal running **ssh**
   A. Remotely ping test the network connection. You may need to configure your DNS or PC's hosts file to associate the IP address to the new hostname.

```
ping <the Pi's IP address>
ping openpdc-pi3
```

   B. For example, use **ssh** in a **git-bash** session in Windows

```
ssh pi@openpdc-pi3
```

   C. Run the standard update commands.

```
sudo apt-get update
sudo apt-get upgrade
```

6. Optional: Install **git**:

```
# Switch to Home folder
cd ~
# Install Git prerequisites – this takes a while
sudo apt-get install build-essential libssl-dev libcurl4-openssl-dev libexpat1-dev tk-
dev gettext -y
# Get
wget https://www.kernel.org/pub/software/scm/git/git-2.9.3.tar.gz
tar xzvf git-2.9.3.tar.gz
cd git-2.9.3
# Make Git takes a while, Install Git is quick
make prefix=/usr/local all
sudo make prefix=/usr/local install
# Test Git
git --version
```

7. Install **unzip**

```
sudo apt-get install unzip
```

Mono Installation on the Raspberry Pi

8. Derived from instructions found in:
   http://www.mono-project.com/docs/getting-started/install/linux/

   A. Mono Installation Script

   ```
   sudo apt-key adv --keyserver hkp://keyserver.ubuntu.com:80 --recv-keys
   3FA7E0328081BFF6A14DA29AA6A19B38D3D831EF
   echo "deb http://download.mono-project.com/repo/debian wheezy main" | sudo tee
   /etc/apt/sources.list.d/mono-xamarin.list
   echo "deb http://download.mono-project.com/repo/debian wheezy-apache24-compat
   main" | sudo tee -a /etc/apt/sources.list.d/mono-xamarin.list
   echo "deb http://download.mono-project.com/repo/debian wheezy-libjpeg62-compat
   main" | sudo tee -a /etc/apt/sources.list.d/mono-xamarin.list
   sudo apt-get update
   sudo apt-get upgrade
   sudo apt-get install mono-devel -y
   sudo apt-get install mono-complete -y
   sudo apt-get install referenceassemblies-pcl -y
   sudo apt-get install ca-certificates-mono -y
   ```

   B. Mono Installation Verification

   ```
   mono --version
   ```

openPDC Server openPDC Software Installation

9. Install openPDC

   A. Download the installation script file

   ```
   cd ~/
   mkdir GPA
   cd GPA
   wget http://www.gridprotectionalliance.org/Products/openPDC/Scripts/install-
   openPDC.sh
   ```

   B. Run the installation with the Preservation option **-p**

   ```
   sudo bash install-openPDC.sh -p
   ```

10. Test openPDC

    ```
    sudo mono /opt/openPDC/openPDC.exe -RunAsConsole
    ```

    While the console is running, type ***version*** to verify the openPDC version, the type ***exit*** to quit.

11. Register openPDC to run automatically

    ```
    sudo bash register-openPDC.sh
    ```

12. Test openPDC control commands. Test them one at a time and wait for each to complete before testing the next command.[40]

    ```
    sudo /opt/openPDC/openPDC stop
    sudo /opt/openPDC/openPDC start
    sudo /opt/openPDC/openPDC restart
    sudo /opt/openPDC/openPDC pause
    sudo /opt/openPDC/openPDC resume
    ```

13. Start openPDC on the openPDC Server and use **openPDCConsole** to assure openPDC is running

    ```
    mono /opt/openPDC/openPDCConsole.exe
    ```

    A. Type ***version*** to check the openPDC version
    B. Type ***exit*** to quit openPDC

14. Install **sqlite3** used for running the openPDC *add-user.sh* script

    ```
    sudo apt-get install sqlite3
    ```

15. Enable Root Login for SSH. This is needed to copy files from Windows to the openPDC Server's data folder on the Pi.

    A. Edit the server's **/etc/ssh/sshd_config** file:

    ```
    sudo nano /etc/ssh/sshd_config
    ```

    Change: **`PermitRootLogin witout-password`**
    To: **`PermitRootLogin yes`**

    B. Restart the ssh service:

    ```
    sudo /etc/init.d/ssh restart
    ```

    C. See: https://linuxconfig.org/enable-ssh-root-login-on-debian-linux-server for details.

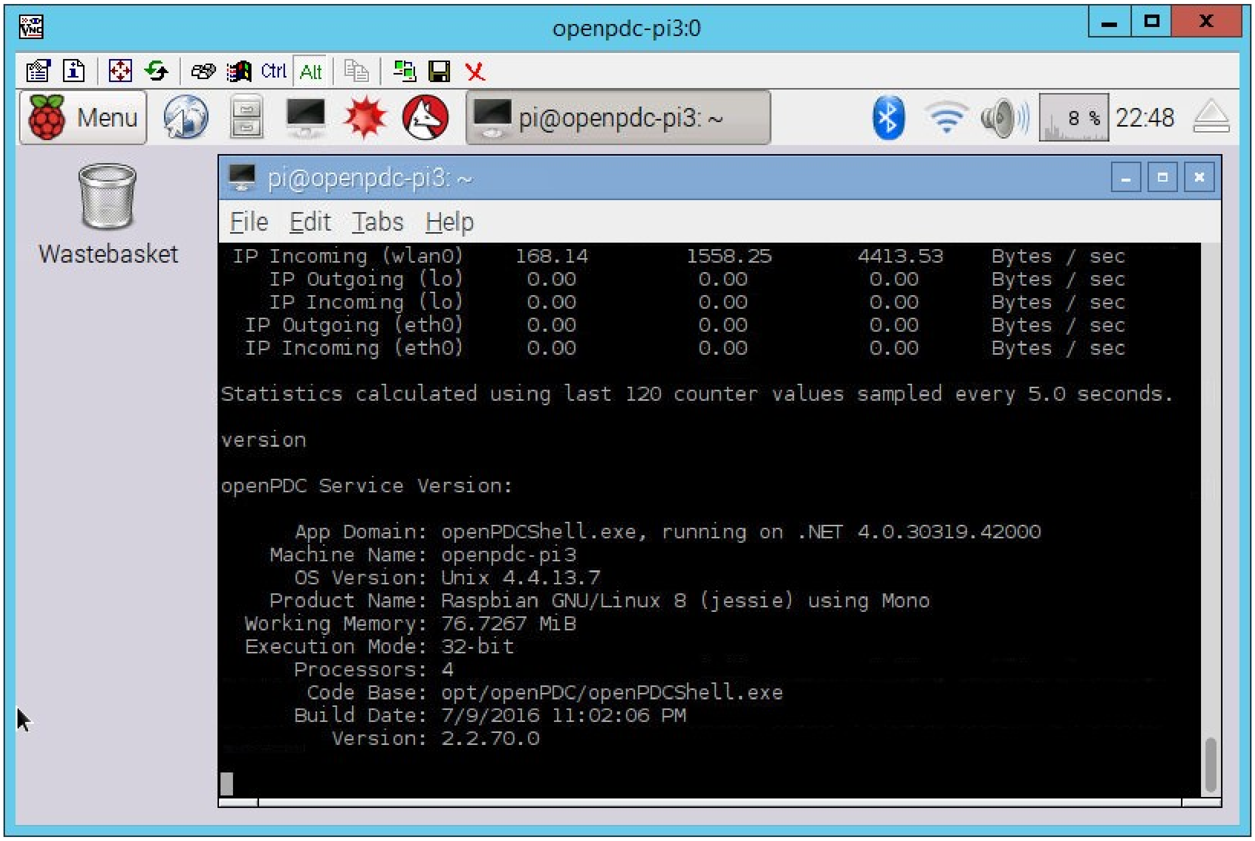
16. Optionally Install and run **x11vnc** to enable Raspbian desktop remote control

    ```
    sudo apt-get install x11vnc
    x11vnc -display :0
    ```

    A. On a remote PC, download **ssvnc** from the following website and run it to connect to the Raspberry Pi. For more information, see: http://www.karlrunge.com/x11vnc/ssvnc.html#download

[40] If these command are executed in quick succession in a script, the abuse may result in openPDC not clearing its process lock file, *openPDC.pid*. In testing, this condition, was fixable by rebooting the Pi device.

17. The following is a screenshot of openPDC running on the Raspberry Pi 3, Model B with 7" display.



```
 IP Incoming (wlan0)    168.14        1558.25       4413.53    Bytes / sec
    IP Outgoing (lo)     0.00          0.00          0.00      Bytes / sec
     IP Incoming (lo)    0.00          0.00          0.00      Bytes / sec
  IP Outgoing (eth0)     0.00          0.00          0.00      Bytes / sec
  IP Incoming (eth0)     0.00          0.00          0.00      Bytes / sec

Statistics calculated using last 120 counter values sampled every 5.0 seconds.

version

openPDC Service Version:

      App Domain: openPDCShell.exe, running on .NET 4.0.30319.42000
    Machine Name: openpdc-pi3
      OS Version: Unix 4.4.13.7
    Product Name: Raspbian GNU/Linux 8 (jessie) using Mono
  Working Memory: 76.7267 MiB
  Execution Mode: 32-bit
      Processors: 4
       Code Base: opt/openPDC/openPDCShell.exe
      Build Date: 7/9/2016 11:02:06 PM
         Version: 2.2.70.0
```